

PROPOSED SCOPE OF THE TEVATRON TUNE TRACKER PROJECT FOR THE PARTICIPATING STUDENT

The main goal of the project is the design and commissioning of a tune tracker for the Tevatron. This tune tracker will be an active system where the beam is tickled with a sine wave and its response measured with existing Schottky detectors. The phase difference between the excited and received sine wave will be measured and used to determine the direction of the frequency shift to make the phase difference 90° . This is the basic idea behind the phase locked loop (PLL) tune tracker. The longer term goal will be the design of a quadrupole feedback loop which will control the tunes up the ramp by using the reported tunes from the tune tracker.

The participating student will have the opportunity to learn and contribute to the project in the following way:

- (i) Understand the theory of betatron tunes, synchrotron tunes and chromaticity.
- (ii) Understand emittance growth behaviour of coherently and noise driven beams.
- (iii) Understand PLLs.
- (iv) Understand the methods for measuring tunes in the Tevatron.
- (v) Calculate and simulate the characteristics of the tune tracker.
- (vi) Program Altera FPGAs.
- (vii) Program Texas Instruments digital signal processors (DSPs).
- (viii) Program microcontrollers.
- (ix) Design and build RF hardware.
- (x) Design and build high speed digital electronics.
- (xi) Interface hardware to the Tevatron control system.
- (xii) Do machine studies to understand and fix problems.

At present, the digital electronics have been designed and some of the software has been written. The first test of the tune tracker is expected to be at the end of this year or early next year.

Finally, the student will also have the opportunity to participate in the high energy physics operations of the Tevatron.

Cheng-Yang Tan
cytan@fnal.gov
Associate Scientist
Fermilab